Assignment 3 - Sample Questions and Answers

Assignment 3 - Sample

Here, we provide a collection of questions and answers that require the geometrical, topological, network, or raster computations using PostGIS functionalities. Similar questions will be included in Assignment 3.

Question 1

Consider a flight from Melbourne (MEL:37.6709S, 144.8433E), to London (LON: 51.4700N, 0.4543W), via Singapore (SIN, 1.3644N, 103.9915E). Compute, in percentage and in kilometres, how much longer is the flight with the stopover in SIN compared to a hypothetical direct flight. You only need to report a result as a table with one record, with two values, “percent” and “kilometres”. For the percentage, report the value as a multiplicative result over the direct distance.

Answer (SQL Query)

```
WITH direct AS
  (SELECT ST_DISTANCE(ST_MakePoint(144.8433,
                        -37.6709)::geography,
            ST_MakePoint(-0.4543,
              51.4700)::geography,
            TRUE) AS distance),
     indirect AS
  (SELECT ST_DISTANCE(ST_MakePoint(144.8433,
                        -37.6709)::geography,
            ST_MakePoint(103.9915,
              1.3644)::geography,
            TRUE)+ ST_DISTANCE(ST_MakePoint(103.9915,
                               1.3644)::geography,

                     ST_MakePoint(-0.4543,
                       51.4700)::geography, TRUE) AS distance)
SELECT 100*(indirect.distance-direct.distance)/direct.distance AS
percent,
       (indirect.distance-direct.distance)/1000 AS kilometres
FROM direct,indirect
```

Answer (Results)

	percent	kilometres
0	0.0483304	8.16935

Question 2

List the names of the 10 world countries with population greater than 25000 people having the shortest borders. The output should include attributes in the following order, named consistently: country name (“name”), border length (in kilometres, “border”) and population (“pop”). Order your output in ascending order of border length. Use the population available in “pop_cntry” column of the “world_countries” table.

Answer (SQL Query)

```
SELECT cntry_name AS name, ST_Perimeter(geom,
                              TRUE) / 1000 AS border,
       pop_cntry AS pop
FROM spatial.world_countries
WHERE pop_cntry > 25000
ORDER BY ST_Perimeter(geom, TRUE) ASC
LIMIT 10;
```

Answer (Results)

	name	border	pop
0	Macau	9.91596	388576
1	Monaco	14.0457	27409
2	Gibraltar	14.9472	28743
3	Guernsey	35.8562	62920
4	Jersey	48.3396	87848
5	Liechtenstein	62.0927	29342
6	Aruba	68.1164	67074
7	Bermuda	74.0293	59973
8	Andorra	86.9912	55335
9	Barbados	89.618	260627

Question 3

Imagine you are planning a cross-country trip from the US state of Utah to Illinois. List, in alphabetical order the names of all interstates (i.e., highways) that directly connect Utah with Illinois. Name the returned column “interstate_name”.

Answer (SQL Query)

```
SELECT c.interstate AS interstate_name
FROM spatial.us_states AS a, spatial.us_states AS b,
     spatial.us_interstates AS c
WHERE a.state = 'Utah'
  AND b.state = 'Illinois'
  AND ST_Crosses(c.geom, a.geom)
  AND ST_Crosses(c.geom, b.geom)
ORDER BY interstate_name;
```

Correct Answer

	interstate_name
0	I70
1	I80

Question 4

Give the name (“name”) and population density (“pop_density”) of the countries that share the border with Brazil, ordered by decreasing shared border length. Use the geometry columns of the table “world_countries” to determine the length of the borders and also for calculating the population density (where Population Density = Population / Area in Square Kilometres).

Answer (SQL Query)

```
SELECT b.cntry_name AS name,
       b.pop_cntry/(ST_area(b.geom::geography,
                    TRUE)/1000000) AS pop_density
FROM spatial.world_countries AS a, spatial.world_countries AS b
WHERE St_Touches(a.geom, b.geom)
  AND a.cntry_name = 'Brazil'
ORDER BY ST_Length(ST_Intersection(ST_Boundary(a.geom),
                   ST_Boundary(b.geom)), TRUE) DESC;
```

Answer (Results)

	name	pop_density
0	Bolivia	7.03921
1	Peru	18.9767
2	Venezuela	21.783
3	Colombia	30.3031
4	Guyana	3.58331
5	Paraguay	11.9692
6	Argentina	12.1525
7	Uruguay	17.3448
8	French Guiana	1.55717
9	Suriname	2.95153

Question 5

A tank truck has travelled from Pelham St (Node 1926) to the BP petrol station (Node 1416) traversing the shortest path via Swanston St (Node 311) and Elgin St (Node 1844). Due to the malfunction in the tank, the truck was leaking petrol on its way contaminating everything in a 20m radius. Your task is to report the total size of the contaminated area in square metres. You can use the tables “carlton_edges” and “carlton_nodes” for your solution. Report a single value for the attribute “area”.

Answer (SQL Query)

```
WITH traversed_edges AS
  (SELECT edge
   FROM pgr_dijkstraVia('SELECT id, source, target, st_length(geom,
TRUE) as cost,
        (CASE WHEN car_rev THEN st_length(geom, TRUE) ELSE -1 END) AS
reverse_cost
        FROM spatial.carlton_edges where car', ARRAY[1926,
          311, 1844, 1416], directed:=TRUE))
SELECT st_area(st_buffer(st_transform(st_union(geom),
                         7855),
                20)) AS area
FROM spatial.carlton_edges
WHERE id IN
    (SELECT *
     FROM traversed_edges);
```

Answer (Results)

	area
0	68269.2

Question 6

What is the total distance travelled in km when walking from node 973 to node 1355 in the University Network (tables “carlton_edges” and “carlton_nodes”). Consider the network to be undirected when doing your calculations.

Answer (SQL Query)

```
SELECT sum(st_length(geom, TRUE))/1000 AS WALK_DISTANCE_KMS
FROM pgr_dijkstra('SELECT id,
                          source,
                          target,
                          st_length(geom, TRUE) AS cost
                   FROM spatial.carlton_edges WHERE foot',
       973, 1355, directed:=FALSE)
JOIN spatial.carlton_edges ON edge = id;
```

Answer (Results)

	walk_distance_kms
0	2.02389

Question 7

The University of Melbourne's athletic team is practising hard. As a part of their training strategy, each athlete is required to walk between 3 to 4 km every day as a warm-up exercise. They wish to undertake different routes every morning for the walk in the university network (tables "carlton_edges" and "carlton_nodes"). Considering that all the athletes meet at "Node 145", and return to this node along the same path, how many nodes in the network can be reached by walking between 1.5 to 2 km (both values inclusive) from Node 145?

Answer (SQL Query)

```
SELECT count(*)
FROM pgr_floydWarshall('SELECT id, source, target, st_length(geom,
TRUE) as cost FROM spatial.carlton_edges where foot',
       FALSE)
WHERE (start_vid = 145)
  AND (agg_cost >= 1500
       AND agg_cost <= 2000) ;
```

Answer (Results)

	count
0	108

Question 8

Find the maximum and minimum elevation above sea level of the Local Government Area of Victoria named "Mansfield". Use the tables "victoria_dem_30_o_2" and "victoria_lgas" in the spatial schema. Report two columns, "max_elev" and "min_elev", in metres.

Answer (SQL Query)

```
SELECT max((ST_SummaryStats(ST_Clip(rast,

  ST_Transform(lga.geom,
    7855)))).max) AS max_elev,
min((ST_SummaryStats(ST_Clip(rast,

  ST_Transform(lga.geom,
    7855)))).min) AS min_elev
FROM spatial.victoria_dem_30m_o_2, spatial.victoria_lgas AS lga
WHERE lga_name = 'MANSFIELD'
AND ST_Intersects(rast,
ST_Transform(lga.geom, 7855));
```

Answer (Results)

	max_elev	min_elev
0	1722.07	233.986

Question 9

Find the name ("name"), length ("length"), the elevation of startpoint (start_elev), elevation of endpoint (end_elev), and elevation difference (diff_elev) of the 10 longest roads in the Melbourne OSM dataset (use the "melbourne_osm_roads" table in the "spatial" schema). Order the results based on the length of the road, from longest to shortest. Use the "victoria_dem_30_o_2" table as a source of the elevation information. You can use the nearest neighbour method to identify the height of a vertex.

Answer (SQL Query)

```
WITH ten_longest_roads AS
  (SELECT osmways.osm_id as id, osmways.name, osmways.way,
          ST_StartPoint(osmways.way) AS startpoint,
ST_EndPoint(osmways.way) AS endpoint
   FROM spatial.melbourne_osm_roads AS osmways
   ORDER BY ST_length(osmways.way) DESC
   LIMIT 10),
     ten_longest_start_end AS
  (SELECT id, name, 'START' AS TYPE,
          ST_StartPoint(way) AS POINT
   FROM ten_longest_roads
   UNION SELECT id, name, 'END' AS TYPE,
                ST_EndPoint(way) AS POINT
   FROM ten_longest_roads),
     join_raster_start_end AS
  (SELECT id, name, TYPE, POINT,
          ST_Value(dem.rast,
            1, ST_Transform(POINT,
                 7855), TRUE, 'nearest') AS elev
   FROM ten_longest_start_end, spatial.victoria_dem_30m_o_2 AS dem
   WHERE ST_Intersects(dem.rast,
           ST_Transform(POINT, 7855)))
SELECT r.name AS name, st_length(r.way) AS LENGTH,
       s.elev AS start_elev, e.elev AS end_elev,
       e.elev-s.elev AS diff_elev
FROM ten_longest_roads AS r, join_raster_start_end AS s,
     join_raster_start_end AS e
WHERE s.type = 'START'
  AND e.type = 'END'
  AND r.id = s.id
  AND r.id = e.id
ORDER BY 2 DESC;
```

Answer (Results)

	name	length	start_elev	end_elev	diff_elev
0	Donnybrook Road	8763.9	220.001	178.866	-41.1345
1	Heidelberg - Kinglake Road	8260.82	81.6649	127.08	45.4153
2	Lancefield Road	7273.63	217.859	279.188	61.3293
3	Hume Freeway	7010.78	174.185	132.882	-41.3024
4	Hume Freeway	6979.06	131.932	173.648	41.7156
5	Craigieburn Road East	6347.91	174.369	166.808	-7.56166
6	Hopkins Road	6277.58	105.695	55.1819	-50.5133
7	Donnybrook Road	6220.52	226.996	219.345	-7.65108
8	Kangaroo Ground - St. Andrews Road	6087.68	155.975	185.83	29.8559
9	Eltham-Yarra Glen Road	5821.38	89.3158	127.382	38.066

Question 10

Find the highest point (elevation above sea level) inside the grounds (i.e., on any campus) of the University of Melbourne. Use “unimelb_campus” table as the University’s area and “victoria_dem_30_o_2“ for the elevation identification. Report the height (“height”), longitude and latitutde coordinates (“lon”, “lat”, respectively), and the name of the campus (“campus”).

Answer (SQL Query)

```
SELECT ST_X(ST_Transform(elev_points.geom,
  4326)) AS lon,
ST_Y(ST_Transform(elev_points.geom,
  4326)) AS lat, elev_points.val AS height, campus
FROM
(SELECT (ST_PixelAsPoints(ST_Clip(rast,

                 ST_UnaryUnion(ST_Transform(unimelb_campus.geom,
                                7855))))).*
FROM spatial.victoria_dem_30m_o_2, spatial.unimelb_campus) AS
elev_points, spatial.unimelb_campus
WHERE ST_Intersects(ST_Transform(unimelb_campus.geom,
          7855),
elev_points.geom)
ORDER BY elev_points.val DESC
LIMIT 1;
```

Answer (Results)

	lon	lat	height	campus
0	143.901	-37.4233	462.086	Creswick